DOCUMENT RESUME

ED 041 458 EM 008 129

AUTHOR	Lee, Richard R.
TITLE	Information Structure in Military History: An Application of Computer-Assisted Instruction.
INSTITUTION	Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.
SPONS AGENCY	Office of Naval Research, Washington, D.C. Personnel and Training Research Programs Office.
REPORT NO	TM-14
PUB DATE	30 Mar 70
NOTE	38p.
EDRS PRICE	EDRS Price MF-$0.25 HC-$2.00
DESCRIPTORS	*Computer Assisted Instruction, *Military Science

ABSTRACT

This report analyzes the course content of Army ROTC Military History, and reports the results of an experimental investigation into the psychological interdependencies among different levels of information. The study also presents two methods of computer-assisted instruction used to teach the principles of war. (Author)

ED041458

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TECH MEMO

INFORMATION STRUCTURE IN MILITARY HISTORY: AN APPLICATION OF COMPUTER-ASSISTED INSTRUCTION

Richard R. Lee

Tech Memo No. 14
March 30, 1970

Project No. 154-280
Sponsored by
Personnel & Training Research Programs
Psychological Sciences Division
Office of Naval Research
Washington, D. C.
Contract No. N00014-68-A-0494

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EM008 129

FLORIDA STATE UNIVERSITY

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
Florida State University
Computer-Assisted Instruction Center
Tallahassee, Florida 32306

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
Information Structure in Military History: An Application of Computer-Assisted Instruction

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Tech Memo No. 14, March 30, 1970

5. AUTHOR(S) (First name, middle initial, last name)
Richard R. Lee

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
March 30, 1970	24	7

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
N00014-68-A-0494	
b. PROJECT NO.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
c.	
d.	

10. DISTRIBUTION STATEMENT
This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Personnel & Training Research & Program Office of Naval Research Washington, D. C.

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FORM (PAGE 1)

DD 1 NOV 65 1473

S/N 0101-807-6811

Security Classification

A-31408

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT

FORM 1473 (BACK)

DD 1 NOV 65

S/N 0101-807-6821

Security Classification

A-31409

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Richard R. Lee

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March 30, 1970

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ABSTRACT

This report analyzes the course content of Army ROTC Military History, and reports the results on an experimental investigation into the psychological interdependencies among different levels of information. The study also reports two methods of computer-assisted instruction used to teach the principles of war. No differences in criterial behavior were found between two methods of principle learning. No relationship was found between subjects' mastery of historical detail and the ability to apply the principles of war to accounts of specific battles. On the other hand, methodological approaches to the utilization of CAI for studying inference making was developed.

PURPOSES OF THE STUDY

Categorization of Factual Material

The rationalization of instruction has been brought about in part by the demands of technological media and by a demand for greater efficiency in instruction. Rationalization entails an elaborated specification of all of the levels of knowledge assumed to be involved in the mastery of a given subject (Bloom, 1956). Little work has been done in history, however. What has been done is aimed at specifying larger objectives and generalizations to be taught (Metcalf, 1963; Skretting and Sundeen, 1969).

The supposition behind a taxonomic task analysis is that the information content of any discipline can be analyzed into constituent elements, and that mastery of higher-level information is contingent upon mastery of subordinate information (Gagnė, 1965). Thus a taxonomy is not only a conceptual framework on which to spread the content of a discipline, it also suggests points at which remediation can be performed.

The most straightforward taxonomy would simply list and categorize the specific items to be learned. Military History, however, is burdened with place names, the names of events, outstanding individuals, dates, strategies plus winners and losers. It is intuitively reasonable to suppose that all factual information in the subject does not carry the same conceptual weight or offer the same resistance to learning.

The ideal taxonomy would specify what kinds of information seem to be grouped psychologically, and which kinds expedite the learning of the larger principles of history.

The structure of information in the sciences has always been clearer than in the humanities. Clearly, one must understand the concepts of mass and measurement encompassed by Boyle's law before gas pressure in an enclosed area can be predicted. The case is not so clear with historical principles; it is possible to understand the principles underlying the causes of the American Revolution, for example, while ignorant of most of the events which led up to it. The connection is even more tenuous between the principles of warfare and the particular events surrounding given battles. In what sense is it facilitative to know the details of the Battle of Gettysburg to learn the tactical lessons from it?

The customary treatment of Military History is to present exemplars of the principles of war embedded in information giving the names of principal commanding officers, antecedent victories and losses, the position and identity of participating units and so on. The first question to be asked is whether any set of particulars suggests a facilitative function in the acquisition of competence in the principles of war. If this can be established, a taxonomic analysis of the different layers of information can serve to optimize instruction. A principle here is defined as a high-level abstraction encompassing a variety of particular cases, and purporting to have predictive power. If, for example, a military commander ignores considerations of

security, mass, and surprise plus fails to capitalize on other principles, the prediction is that he will be defeated in an encounter with an opponent.

Historical principles differ from those in the physical sciences in several ways: first, in the degree of precision possible in the description of a situation, and in the lack of immutability in the function of the principles in a given situation. Historical principles also have an axiomatic feature lacking in scientific principles; rather than being neutral explanations of impersonal states or events, they are in a sense a guide to action. This, of course, is why they are taught to cadet officers.

One goal of this research, then, is the differentiation of levels of information within the discipline of history in psychologically meaningful terms. Experiments in verbal learning long ago established that single words cluster in memory on the basis of common dimensions of meaning (Mandler, 1968). The name of a battle and its location are both information-level facts. The question that will be pursued is this: Do subjects group information about history in particular ways? In psychological terms, are there cognitive processes that characterize the storage and retrieval of information transmitted through extended meaningful discourse? A pedagogically useful taxonomy of historical material would be relatable to systems of cognitive organization common to a large portion of the subject population.

Naturalistic systems of organization are usually treated as rhetoric, which is a method of structuring the details of extended discourse for effective transmission. The methods are as old as Classical

Greece; they include temporal sequencing, comparison and contrast, and illustration and definition. The rhetorical arsenal of the contemporary writer is not well defined in any scientific sense, but the common application of rhetorical analysis throughout centuries of Western history presupposes common organizational strategies on the part of the audience. Whether these are learned conventions or inherent properties of intellect is of little moment to the present study. What is important is that they suggest naturalistic groupings of the factual information found in military history.

The historical convention follows a time sequence, and like the story teller, departs from it only to relate affairs occurring simultaneously with events already related. Ordinary narration sequences episodes together; the military historian typically sequences battles and campaigns. What is learned, then, is the events chunked together in a code which includes information about the temporal proximity of the events. In taxonomic terms, one category of information includes the names of battles and campaigns of a war, strung together on a time line.

One feature of military history that might weaken the effectiveness of this organizational device is the sheer mass of factual information presented. Unless each battle is narrated in some detail, the result may look like a string of battle names rather than a series of episodes, which reduces the story line to a series of labels without discernible referents. Another problem is the psychological differentiation of a time continuum into more manageable units. Extended narration could conceivably be reduced to a hierarchical

structure if the subject sensed some transition from one period to another. This is apparently the motivation for the naming of campaigns; these can hypothetically serve as nodes in a tree structure of time.

Another possible organizing strategy is a partisan differentiation of events on the basis of victories and defeats. The primary element learned in this case is the name of a commander associated with certain battles, plus a binary designation, winner or loser. Military historians frequently reflect this human fascination with human struggle by selecting events for scrutiny all out of proportion to the strategy of the encounter. Both Lee's and Meade's conduct of the battle at Gettysburg was pedestrian, and the strategic importance of this encounter is not particularly clear, and yet, the vision of the noble Virginian enmeshed in a dying cause has generated interest among military historians for over a century. It might well be that the learner attends more to human endeavor in combat, particularly the conduct of persons with whom he feels loyalty or sympathy.

History shares with fiction the tendency to delineate character by showing it in conflict, and to attend to the fate of armies and men rather than battles and campaigns. Memory load in this case would be much lighter than a chronological ordering of events since the subject would ignore much detail in favor of information that attaches to persons and outcomes.

Military histories usually include maps of critical battles and details of maneuvers. Psychologically, the history of a war could be thought of as the encoding of a spatially structured representation of the physical occupation of regions and vectors of movement, a cognitive

map in the most literal sense. Information about a campaign or war could thus be recorded and remembered in primarily non-verbal form, with the additional feature that, in the case of military campaigns conducted in the United States, the subject can superimpose information on a mental map which has already been established through repeated contact with school geography, road and weather maps, and allusions encountered through the new media to places in the United States.

The three categories of information listed above - temporal, partisan, spatial - do not exhaust the logical possibilities of a taxonomic analysis of military history, but they were considered sufficient for present purposes to explore the notion that psychological structuring of information may take place in fairly predictable directions. The optimal curriculum would be the intersection of the least amount of information consonant with adequate criterial behavior, and the most efficient organization of that information.

Subjects

Subjects were thirty second-year college males enrolled in the Army ROTC program at Florida State University selected from the entire class of sixty-five students. All were enrolled in a mandatory course in military history.

Procedures

Subjects were given four hours of classroom instruction in the military operations of the American Revolutionary War with particular emphasis given to the details of the New York campaign. They were also instructed to read the relevant chapters in the ROTC manual before they

began CAI instruction. Computer instruction was performed on the IBM 1500 at the Florida State University Center for Computer-Assisted Instruction. Subjects were seated before individual terminals consisting of a cathode ray tube, which displays text material, and two response features, a keyboard and a light pen. All questions were displayed in a multiple choice format. Subjects had thirty seconds in which to respond, either by typing the letter of the correct answer or touching the appropriate place on the screen with the light pen. If a subject took more than thirty seconds to respond, an overtime switch was set and the text material immediately redisplayed. Two successive overtimes or a wrong answer called up a display of information relevant to answering the question. After the student read the display, the program branched him back into the question to elicit a second pass correct response. If this failed, the correct answer was displayed on the screen.

Questions were of four types. One was the organization of battle names into chronological order within a particular campaign. The number of battles from the campaign was specified in the item: Put in chronological order the three battles from the British invasion of the South:

a. Battle of Charleston,

b. Battle of Cowpens,

c. Battle of Waxhaws,

d. Battle at Savannah.

A first time correct response was registered if the subject excluded the irrelevant battle and placed the correct three battles in the campaign in proper chronological order.

A second category of questions required the subject to identify which prominent commanding officer was present at a given battle. Responses and distractors were selected from those individuals who were prominently involved throughout the war and whose names were likely to have been encountered in allusions to American history outside the context of military history courses.

A third kind of question required the subject to simply identify the victor of a particular battle either by nationality or by name if it could be assumed that an identification of one was tantamount to identification of the other, as in the case of General Howe or General Washington.

A final category of questions dealt with troop movements during the course of the war, either in terms of direction or distance. Upon initial display of the text, subjects were directed to maps in their textbooks which they had at the terminals with them. But the overtime function of the program made it extremely unlikely that the subject could extract relevant information from the map within thirty seconds, the boundary for a first time correct answer. There was a total of 59 response frames in this segment of the program.

Results

Student records were examined for first time correct responses. In the identification of battles by chronological order 27.5 percent were correct. Identification by name of a commanding officer involved in a particular battle yielded 33.0 percent correct. Determination of relative directions or distances between related place names yielded 39.5 percent correct and the identification of victor of individual

battles was correct 54.8 percent. Of the four response categories, only one, victors, is significantly above the chance level for guessing. (See Figure 1)

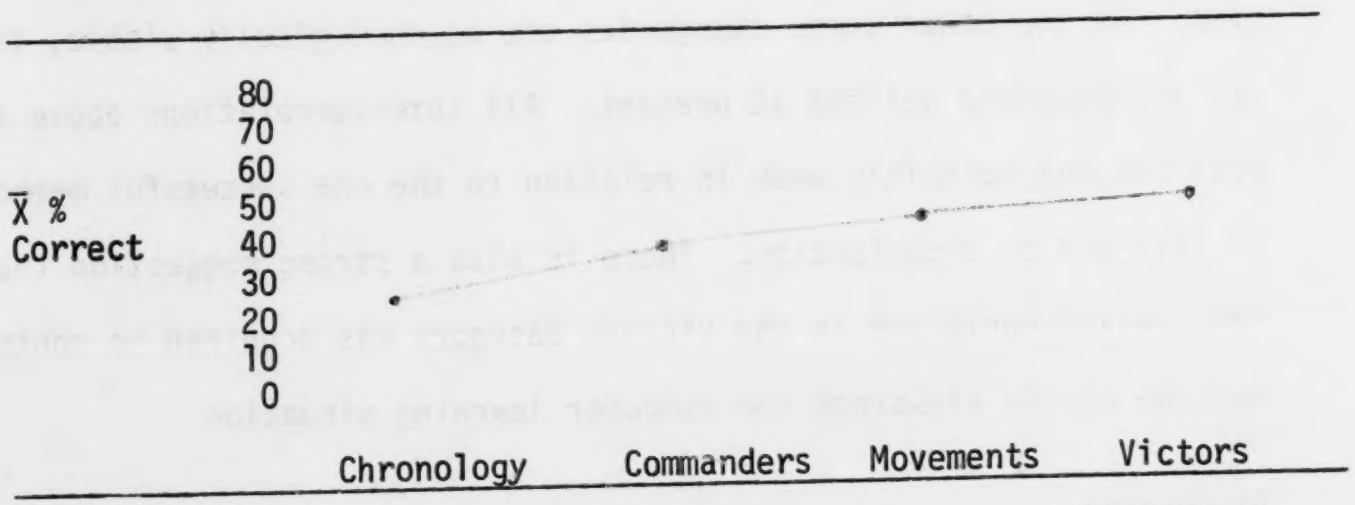

Figure 1--Proportion of First-Pass Correct Answers by Information Type

First time correct answers for the different categories of information were examined for intercorrelations. (See Table I)

TABLE I

INTERCORRELATIONS OF FIRST-PASS CORRECT ANSWERS BY INFORMATION TYPE

	COMMANDERS	MOVEMENTS	VICTORS	TOTAL
Chronology	.282	.765**	.118	.671**
Commanders		.313	.368*	.691**
Movements			.014	.572**
Victors				.638**

* $p < .05$

** $p < .01$

Of the four logical categories posited as possible organizing strategies, only one, victors, elicited performance above the chance level. An examination of the intercorrelation table fails to produce evidence that the other logical categories function as organizing strategies. If the other three categories are psychologically viable, they are inadequately defined at present. All intercorrelations above are positive but certainly weak in relation to the one successful method of information organization. There is also a strong suggestion that the information contained in the victors category was acquired in context outside of the classroom and computer learning situation.

Discussion

The extremely high error rate in all categories of information except the victors of particular battles confirms the intuitive notion that the particular manual in question offers far more information than can be assimilated by the cadet officer without special drill and practice. One exception is performance in the victors category, which is far above the chance level. This category differs from "commanders" in that the victors are in general better known to the public at large. There is no guarantee here that performance is a direct result of learning either in lecture or through CAI. Psychologically, there is an innate appeal in decisive encounters that result in clear victory, a feature that history shares in common with fiction. In terms of information storage and retrieval, military history can be, and apparently is, learned simply as a conflict between two sides with significant episodes marked again in a simple binary fashion, won or lost. It is also apparent from the above findings that chronological ordering among

battles is not a device used with any efficiency by these subjects. This procedure is probably blocked by the arbitrary nature of battle names. These labels probably refer to significant events for the historian, but for the undergraduate student, they appear to have all of the arbitrariness of nonsense syllables. If the historian wished to capitalize on the organizational conventions of the standard narration, each battle would have to be amplified to the dimensions of a genuine episode, and the amount of material would become voluminous.

The manual currently in use in Army ROTC appears to be indiscriminate in the details that it selects for presentation. The CAI material is much more selective than the manual, but it is dependent on the manual. It is hypothesized that the sheer mass of information in the manual presents a learning task of such magnitude that it discourages the subject from attempting to master any significant part of it.

Instructional Strategies for the Learning of Principles

The question was posed whether certain shortcut strategies might be discovered to teach the principles of war. Since these principles each can run the length of twenty-five to thirty words, the standard technique of presenting the full text and reducing the amount of information in succeeding frames can add up to a fair amount of shared time on the computer. The vanishing technique also encourages passive learning behavior from the subject while the program shapes his behavior. It was reasoned that attention could be sharpened by forcing the subject to bring his knowledge of linguistic structure to bear on connected discourse to provide the low-information functions such as prepositions, conjunctions and articles.

Subjects

Subjects were sixty sophomore, Army ROTC cadets enrolled in Military History. They were randomly assigned to two groups of equal size.

Procedure

The first treatment group was exposed to 45 frames of instructional material on the IBM 1500. Subject was first presented with a frame to memorize the definition. For example:

> Security is defense against surprise or unhindered attack. Security considerations must be made at all times in the combat zone whether planning, fighting, or resting.

The next step would be the presentation of the definition with only a blank line where the word "security" appeared. The subject responded by typing the name of the principle. (In early versions of this program, it was found necessary to teach the students the correct spelling of each one of the principles so that correct answers would not be rejected for misspellings.) The third step was the presentation of a further reduced frame and the elicitation of a typed response. For example:

_____defense against surprise _____._____ all times _____combat zone _____.

In addition, the name for each of the principles was attached to a schematic diagram that built up cumulatively through all nine of the principles. Systematic review was accomplished by presenting the most minimally reduced frame during the second step of the presentation of the next principle. Subjects had thirty seconds to respond before

timing out. Upon making an error or timing out twice, the subject was presented with the correct answer.

The second treatment group was presented with only one frame of incomplete definitions for each of the principles. These maximally reduced definitions contained only key content words. Response was multiple-choice rather than constructed. A full definition appeared only as feedback to a wrong answer. The initial frame would look like this

_____ x defense x surprise x unhindered
attack. _____must be made x x times x x
combat zone x planning, fighting x _____ x
resting.

An introductory frame explained that each occurrence of "x" represented a deleted word. This technique is similar to a close procedure, except that no reward or feedback is provided for filling in the function words, except as incidentally contributed by the full definition which would appear as wrong answer feedback.

Results

An external validity measure was made calculating score obtained in applying these principles of warfare to descriptive quotations extracted from the text. An analysis of variance revealed insignificant differences in criterial performance between the two groups ($F = .08$.). A correlation was calculated between the number of first-pass frames encountered in the two methods of instruction and the total correct-answer score obtained in the application of the principles. The total-time hypothesis would predict high positive correlation between the

number of frames of instruction and performance on the criterial task. The correlation was close to zero (r = .041.).

Discussion

It can be assumed here that students had no prior knowledge of the principles of war apart from the awareness that they existed. The text makes fleeting reference to them, but the definitions were reworked substantially for the CAI material. In pragmatic terms, these results suggest that amount of writing time and programming time as well as learning time can be substantially reduced by capitalizing on the game-like quality of reconstructing full discourse from telegraphic text. A common complaint in programmed instruction is that better students find it tedious. The key-word technique appears to be arousing since it asks the subject to implement his knowledge of English to complete the task. There is no apparent loss of efficiency in learning the principles when compared to standard vanishing techniques.

The Application of Principles to Historical Situations

The following study was conducted with the purpose of determining the feasibility of teaching higher-level thought processes through automated instruction, specifically the evaluation of tactics used by commanders of the past. Limitations of time and the extent of instructor preparation sharply restrict the amount of evaluative behaviors that can be induced in the course of ordinary classroom activities during the teaching of Military History. This situation is created, in part, by a high rate of instructor turn-over in R.O.T.C. detachments. Too, the principles of military tactics are disjunctive concepts (Bruner, et al.,

1956). As in the study of law, philosophy or literature, the criterial attributes, in this case, the facts of military tactics, compete with one another for inclusion in the process of evaluation. Descriptive studies of classroom behavior show repeatedly that instructors tend to avoid asking questions other than the recall of simple fact. Computer-assisted instruction (CAI) permits the storing of higher-level questions and the scoring of a wide variety of answers that are theoretically possible in the classroom but that are seldom seen.

A textbook description of a tactical situation resembles the tactical situation itself in that there is always insufficient information available to decide unambiguously whether a commander observed or violated a principle. The historian inevitably selects some information and ignores other facts as he narrates. The cadet or the commander is always in a state of partial ignorance, and is forced into making tactical decisions with limited information about the disposition of aggressor forces and the state of readiness of his own troops. For these reasons, it was determined that answers should reflect the degree of certainty possible from the amount of information made available in the quotation.

Since the principles are structured, it is possible to make inferential judgments on the basis of limited information. There is also an intuitively discernible line between inference from limited information and pure guessing. The student and the troop commander should both be sensitive to the gradient between fully rational decisions and forced random selection of possible alternatives.

Procedures

Subjects were 60 male undergraduate students enrolled in the Army R.O.T.C. program at Florida State University. Prior to this portion of the curriculum, they were assigned to four treatment groups to test the effect of the learning of factual information and two styles of principle learning. Thus, subjects had varying amounts of computer-assisted instruction before exposure to the principles of war.

Group I (N-15) factual review and principle learning by vanishing technique

Group II (N-15) factual review and principle learning by key-word method

Group III (N-15) no factual review and principle learning by vanishing technique

Group IV (N-15) no factual review and principle learning by key-word technique

In this section of the experiment, they were presented with quotations, two to three sentences long, adapted from the classroom text, describing the conduct of operations during the New York campaign of the Revolutionary War. Quotations were presented on a flip chart next to the CAI terminal; on the CRT were displayed the names of the nine principles and five possible answers. Thus, for every description of an encounter, the subject passed judgment on commanders' adherence to each of the nine principles and then was asked to make the same judgments on the performance of the opposing commanders. For each principle, one of five responses was selected: 1. clearly observed; 2. probably observed; 3. not applicable; 4. probably violated and 5. clearly violated. An introductory frame explained that only one of five answers was per-

missible and that the pragmatic outcome of the encounter, historically, would not be taken into consideration. This was done to stress the fact that successful military operations often violate some of the principles to capitalize on others. "Not applicable" was to be used if there was insufficient information in the quotation to make a reasoned judgment.

Results

The mean score correct for all applications of the principles was 38.1 percent. (Each question had five possible answers, so 20 percent correct would have been possible by random guessing alone.) Figure 2 shows that with the one exception of question type "flexibility of maneuver," subjects found one principle of war about as difficult as another. These results obtained despite the artificially simplified analog of instructor behavior caused by pooling the answers of four instructors of Military History into a single correct response.

Poor performance on "flexibility of maneuver" suggests that factors other than reference to the concepts contained in the principles accounted for a share of the correct responses. Coded correct answers were not randomly distributed from "clearly observed" to "clearly violated." The brevity of the quotations dictated a preponderance of "not applicable" correct responses. By chance, "flexibility of maneuver" did not reflect this response bias, and as a result, student performance was lower on this principle. This fact tends to weaken the conclusion that all performance beyond the chance level is the result of cognitive processing.

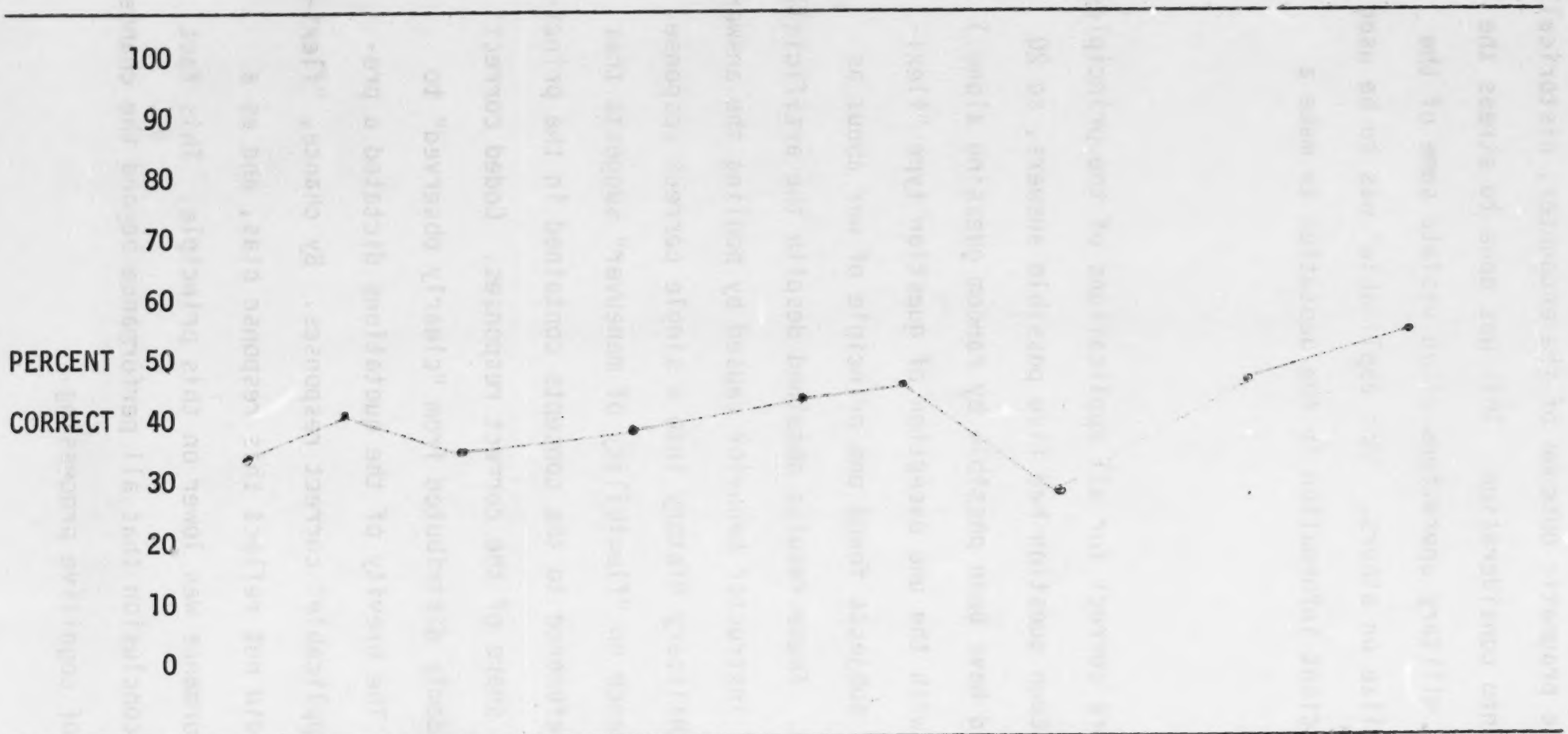

Figure 2--Mean Correct Answers by Type, All Groups

TABLE II
ANSWER DISTRIBUTION

	Clearly Observed	Probably Observed	Not Relevant	Probably Violated	Clearly Violated
Security			9		5
Unity of Command		4	9		1
Objective	3	2	8	1	
Offensive	5	1	4	3	1
Economy of Force		2	12		
Mass	5		8		1
Flexibility	2	5	2	2	3
Simplicity		3	11		
Surprise	3	2	8	1	
TOTAL	18	19	71	7	11

It will be recalled that "flexibility of maneuver" and "simplicity of maneuver" were presented to show a reciprocal relationship; a commander cannot have both at once. The expectation would be that high performance on one would yield high performance on the other. The same relationship also obtains between "economy of force" and "mass." The results above do not suggest that subjects capitalized on this logical interrelationship in the application of these particular principles, or if they did, other factors created enough noise to obscure the relationship.

An analysis was made of the relationship between performance in the factual part of the curriculum and performance in the application of principles. The 30 subjects who encountered the factual portion of the curriculum had substantially more instruction than the 30 no-facts subjects. The factual portion of the curriculum measured initial behavior and, through the wrong answer branching, ensured subjects had command of the information before they proceeded. Table III presents the mean scores by group in the application of principles, out of a possible score of 126.

TABLE III

MEAN SCORES, APPLICATION OF PRINCIPLES

	Facts	No Facts
Key Word	53.80 (N=15)	57.20 (N=15)
Vanishing	60.27 (N=15)	57.73 (N=15)

Casual inspection of the table suggests that exposure to the factual information did nothing to enhance performance in the application of principles.

An analysis of variance was computed to test treatment effect by group ($F = .019$, 57 d.f.). This finding gives support to the idea that there is no causal relationship between the mastery of historical facts and the appreciation of historical principles. This interpretation is born out by the nearly complete lack of correlation between first-pass correct scores in the factual portion performance in the principle section ($r = .023$, $n = 30$).

Reference to Table III above shows that groups with the lowest performance (facts + key word) performed least well on the application of principles. While this difference is not significantly lower, this fact plus the results of other analyses suggests that two entirely different areas of human cognition are represented in the acquisition of factual information and the application of historical principles.

Discussion

This study fails to support the viability of a taxonomic description of Military History as a major consideration in the organization of a curriculum. In the section entitled "Categorization of Factual Material," historical facts were ordered by chronological sequence, by associating persons and encounters, by victor and by spatial organization. First-pass correct answers fell below any reasonable criterion, which suggests that students made little use of these organizational strategies before instruction on the computer. In the section entitled, "Instructional Strategies for the Learning of Principles," the principles of war were

ordered in logical relationships, but the carry-over into the applications of those principles into the section entitled "The Application of Principles to Historical Situations" failed to demonstrate that any benefit accrued, even in the case of principles reciprocally related. Additionally, no advantage accrued to subjects who learned facts systematically in the first section, when compared with subjects who skipped this portion of the curriculum.

Stated another way, no intersection was found between a logical analysis of the material to be learned and subjects' learning strategies. A taxonomy deals only with the organization of facts; it does not select facts which may be intrinsically more interesting to the student. The extremely low performance in the first section suggests that motivation to learn played a larger role than the opportunity to acquire a body of data. It is noteworthy that overall performance in the last section, although of a much more complex nature, tended toward higher scores. There is a game-like quality in evaluative behavior that is lacking in the learning of simple fact. The motivation variable contaminates many of the results of this study to the extent that it cannot be considered an acid test of the viability of a taxonomic analysis.

There are pragmatic implications, however. Unless evidence can be found to the contrary, future revisions of the Army R.O.T.C. manual in Military History should prune much of the factual detail and emphasize how certain commanders won or lost battles within the framework of tactical principles. The mass of detail found in the present manual is reflected in the first section of this curriculum. A close test of how much was actually learned from the manual suggests that subjects glossed

over all information, possibly because learning any of it appeared to be a task of insuperable proportions.

One clear finding is that considerable programming and instruction time can be saved by using key word definitions for primarily verbal concepts. The deletion of grammatical functors appears to cost nothing in terms of efficiency of learning, a fact which can be explained by the game-like quality of the activity, and its putative effects on motivation.

The question whether computer-assisted instruction can be used to stimulate higher level cognitive processing of information in Military History is still open to question. A less equivocal answer could be reached if future research were to capitalize upon the computer's ability to accept a variety of answers to reflect the fact that instructors of Military History themselves do not always agree about answers to evaluative questions. Apart from the factual information contained in it, Military History also serves as a socializing function for cadet officers. Benefit should accrue both in terms of motivation and socialization from earning a score which shows the cadet the degree to which his reasoning and answers match those of his instructors. The preparation of CAI material would be made much more complex in this way, but this kind of activity would more closely approximate the ideal learning situation of a one-to-one relationship between instructor and student-cadet.

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